SURFACE GEOCHEMICAL PROVINCES OF THE ESPÍRITO SANTO BASIN, SOUTHEAST BRAZIL

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Introduction

Espírito Santo Basin is comprehended between Vitória-Trindade seamounts and Abrolhos bank, southeast, Brazil, and it is morphologic characterized by shortage of submerse channels that contributes the transport of terrigenous material from continental shelf to deeper basin areas. Transport of terrigenous material to oceanic basin is mainly from atmospheric and continental (rivers) input. These ways can carrier not only natural but anthropogenic elements, such heavy metal, which depending of the amount could cause severe damages on the biota and environment. Residual (total) and bioavailable fractions of metals (Al, Fe, Ba, B, Cu, Cr, Pb, Cd, Zn, Ni, V, Mn, Mg and Hg) and metalloid (As) in surface sediments of Espírito Santo Basin (continental shelf and slope), Brazil, were geochemical evaluated regarding their distribution, origin and associated processes. Results indicate those elements associated with terrigenous deposits in both continental shelf and slope with possible influence of Doce river as major source.

Methods

Surficial sediments were collected in 70 stations (7 transects x 10 points) covering the continental shelf and slope. Major and trace elements were analyzed in all samples by partial (bioavailable) and total (residual) extractions, using HNO_3 and 9:4 HNO_3: HF, respectively. The extractions were conducted by microwave digestion according EPA 3051A (partial) and EPA 3052 (total) followed by ICP-MS analysis.

Results

Concentrations of all samples are present in Table 1. Mg and Fe values showed variation between the seasons, being Fe higher at summer possibly associated with higher continental discharge at this rainy season. Magnesium is natural concentrated in the sediments of Espírito Santo basin because a bioclastic carbonate rich characteristic of the sediment. Cr, V, Fe, Ba, Ni, Cu and Al are strong associated with a terrigenous input, whereas elements as Mg, As, Cd and Sr are directly influenced by biogenic carbonate deposits.

Metals and metalloid concentrations showed an evidently difference between continental shelf and slope. Both residual and bioavailable fraction of Al, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Ba e Pb presented a high variation between 400m and 1300m depth, indicating a transitional region of deposition of these elements. Hg showed an association with fine particles which is related with colloidal fraction aluminum oxides and hydroxides, being atmospheric deposition an important source.

Table 1. Minimum, maximum and mean values for major and trace elements in total and partial extractions in Espírito Santo basin at summer and winter season.

Elements		Espírito Santo Basin (summer)		Espírito Santo Basin (winter)	
		Extraction			
		Partial	Total	Partial	Total
B	Min. - Max	6,59 - 65,24	-	1,94 - 36,43	-
	Mean	**36,15**	**-**	**15,70**	**-**
Mg	Min. - Max	1,86 - 23,71	2,47 - 25,2	0,89 - 22,10	0,90 - 22,46
	Mean	**8,09**	**9,37**	**6,57**	**7,95**
Al	Min. - Max	1,41 - 29,22	2,17 - 38,02	1,16 - 20,07	1,90 - 78,97
	Mean	**10,55**	**15,85**	**8,61**	**14,85**
Mn	Min. - Max	31,75 - 1288,82	35,65 - 1766,57	21,14 - 1062,59	14,24 - 3502,73
	Mean	**422,69**	**499,93**	**219,60**	**436,76**
Fe	Min. - Max	2,09 - 58,02	2,68 - 61,83	1,20 - 26,22	1,95 - 70,22
	Mean	**20,69**	**23,10**	**9,50**	**13,52**
Sr	Min. - Max	0,15 - 5,94	0,18 - 6,93	0,07 - 3,31	0,13 - 4,47
	Mean	**1,84**	**2,12**	**1,05**	**1,27**
V	Min. - Max	2,54 - 104,82	3,52 - 108,99	0,97 - 43,28	2,07 - 100,54
	Mean	**42,78**	**48,67**	**19,29**	**42,91**
Cr	Min. - Max	6,22 - 84,53	8,80 - 103,83	1,95 - 33,48	7,25 - 89,52
	Mean	**32,33**	**39,31**	**13,58**	**28,92**
Ni	Min. - Max	2,22 - 29,93	4,27 - 91,12	0,62 - 11,63	2,80 - 38,43
	Mean	**15,86**	**21,97**	**7,07**	**17,13**
Cu	Min. - Max	0,24 - 27,83	0,16 - 39,13	0,29 - 9,30	0,70 - 29,76
	Mean	**10,60**	**15,62**	**4,73**	**14,59**
Zn	Min. - Max	3,64 - 28,98	4,77 - 92,18	0,07 - 23,76	3,17 - 90,29
	Mean	**14,75**	**33,42**	**10,69**	**44,75**
As	Min. - Max	5,00 - 31,04	37,20 - 87,09	3,86 - 30,52	22,25 - 104,39
	Mean	**13,11**	**54,17**	**11,81**	**52,35**
Cd	Min. - Max	0,02 - 0,11	0,02 - 0,74	0,02 - 0,19	0,02 - 0,77
	Mean	**0,06**	**0,28**	**0,08**	**0,19**
Ba	Min. - Max	3,78 - 172,12	10,85 - 315,17	1,68 - 149,66	4,51 - 210,00
	Mean	**47,39**	**77,83**	**45,69**	**82,63**
Pb	Min. - Max	0,82 - 20,92	1,12 - 37,98	0,64 - 16,36	0,75 - 29,60
	Mean	**8,86**	**15,44**	**7,15**	**10,92**
Hg	Min. - Max	-	1,66 – 62,41	-	<1,00 – 62,41
	Mean	**-**	**13,40**	**-**	**15,60**

Conclusion

Sr, Mg, Ca and As presented an association with bioclastic carbonate sediments and some metals (Cr, V, Fe, Ba, Ni, Cu and Al) showed strong association with terrigenous input. Among the study elements, both residual and bioavailable fractions of Al, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Ba e Pb showed a transitional deposit region between 400m and 1300m. There is the occurrence of two distinct geochemical provinces, directly influenced by the variation in carbonate content and hence the concentration of biogenic elements associated with these deposits. This separation occurs between the samples from the southern and northern part of the Continental Shelf, which have, respectively, higher and lower content of carbonates, Sr and Mg. For most of the elements isobaths 400m, 1000m and 1300m are those with this variation in the concentration in relation to other depths.

References

Akca, L.; Kinaci, C.; Karpuzcu, M. (1993). A Model for Optimum Design of Activated Sludge Plants. *Water Res.*, *27*, 1461-1468.

Billing, A.E. (1987). Modelling techniques for biological systems. *M.Sc. thesis*, Dept Chem. Eng., Univ. of Cape Town, Rondebosch 7700, South Africa.

Ekama, G.A.; Barnard, J.L.; Gunthert, F.W.; Krebs, P.; McCorquodale, J.A.; Parker, D.S.; Wahlberg, E.J. (1997). Secondary Settling Tanks: Theory, Modelling, Design and Operation.; *IAWQ-6*, London, U.K.

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